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Journal of the Society of Arts.

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FRIDAY, DECEMBER 11, 1868.

Announcements by the Council.

ORDINARY MEETINGS.

Wednesday Evenings at eight o'clock :—

December 16.—"On Artificial Freezing." By Dr. B. H. Paul.

December 23.—"Description of the Electric Organ." By Henry Bryceson, Esq.

CANTOR LECTURES.

The first Course of Cantor Lectures for the present Session, the subject being "The Aniline or Coal Tar Colours," is now being delivered by W. H. Perkin, Esq., F.R.S., on Monday evenings, as follows :—

LECTURE II.—MONDAY, DECEMBER 14TH.

Mauve, Magenta, and some of their Derivatives.

Chemical nature of mauve—Runge's blue—Magenta: its discovery and manufacture—Phosphine—Bleu de Lyon—Bleu de Paris—Violet Imperial—Hofmann's violets—Britannia violets.

LECTURE III.—MONDAY, DECEMBER 21ST.

Various Aniline, Phenol, and Naphthalin Colours—Application of the Coal Tar Colours to the Arts.

Aldehyd green—Iodine green—Perkin's green—Aniline pink—Black, browns, &c.—Phenol—Picric and isopurpuric acids—Aurine, coralline, and azuline—Naphthalin yellow—Chloroxynaphthalic acid, &c.—Application of the coal-tar colours to the arts of dyeing and printing—Paper staining and colouring—Lithographic and other printing.—Conclusion.

Each lecture will begin at eight o'clock. These Lectures are open to Members, each of whom has the privilege of introducing two friends to each Lecture.

Other courses are being arranged, particulars of which will be announced.

INSTITUTIONS.

The following Institution has been received into Union since the last announcement:—

Alnwick Scientific and Mechanical Institution.

SUBSCRIPTIONS.

The Michaelmas subscriptions are due, and should be forwarded by cheque or Post-office order, crossed "Coutts and Co.," and made payable to Mr. Samuel Thomas Davenport, Financial Officer.

Proceedings of the Society.

FOOD COMMITTEE.

The Committee met on Wednesday, 18th instant; present—Mr. Benj. Shaw (in the chair), Mr. E. Wilson, Mr. W. H. Michael, Mr. G. F. Wilson, F.R.S., Mr. J. T. Ware, and Mr. Seymour Teulon.

Mr. George Barham, managing director of the Express Country Milk Company, Museum-street, attended before the Committee, to give evidence relative to the conveyance and distribution of milk to London, &c.

Mr. Barham stated that Mr. Alexander Wood, deputy-chairman of the Great Western Railway Company, had expressed an opinion before the Committee that it was desirable that the size of the cans in which milk is brought to London by railway should be reduced from a capacity of eight barn gallons to about one-fourth that size, with tight-fitting lids, after the fashion of the French cans; also, that the vessels should be completely filled, so as to prevent disturbance of the particles of the milk by motion in transit. He (Mr. Barham) thought it was not desirable to reduce the size of the cans to the extent suggested, if at all, because, he said, the present large cans could be rolled along the platform of a station quicker than small cans could be carried the same distance by hand, the latter being so short that it would be impossible to roll them on the bottom, as was done with those now in use, which are protected at the bottom by a stout iron rim. The shaking of the milk in the conveyance would not be greater in a large can than in a small one, provided in both cases they were filled thoroughly full. His own opinion was, that if the milk were in a cool state before it was put into the cans, the shaking would have no prejudicial effect upon it. The great secret of getting the milk in good condition was in allowing it to cool sufficiently before being placed in the cans. A large quantity of milk arriving at night was left standing at the station till four a.m., when it was fetched for delivery. If the milk were put into the cans warm, and the lids were kept on all night, it would acquire a bad smell, and it would take two or three hours for that smell to pass off.

Mr. Michael inquired to what extent milk was influenced, and caseine deposited by agitation in contact with air?

Mr. Barham replied if the milk were packed at a temperature of 50° to 60° Fahr., the particles would not be injured by the agitation. It was very difficult to make butter with milk at that temperature. They might be all day over it. If the milk were packed at 70° or 80° Fahr., the agitation would tend to separate the butter, and to promote the deposit of caseine. If the temperature of the air were not higher than that of the milk, he thought no injury would be occasioned by the admission of the air to the milk whilst it remained in the cans.

Mr. Seymour Teulon suggested that, in addition to the space which the present size and form of the cans occupied unprofitably in the van, they could not be loaded and unloaded by one man.

Mr. Barham said it required two men to lift the loaded cans into the van. There were always plenty of hands at the station to do such work; smaller cans, no doubt, could be lifted by one person. That was the great difference between the two sizes. One man could lift an eight-gallon can out of the van, but could not lift it in alone. But there was always a porter to assist at all the stations, and the larger consignees in London generally had two men at the station.

Mr. Michael suggested that great economy of space in the vans would be gained by the cans being made in the form of a parallelogram, instead of circular with a considerable taper towards the top, whereby a great deal of space was wasted.

Mr. BARHAM replied the rectangular form might answer if the cans were of an easily portable size, but they could not then be rolled along the platform, as were the cans at present in use, and they would be very much battered at the angles. Another objection to the parallelogram form would be the difficulty of keeping the vessels perfectly sweet and clean.

The CHAIRMAN inquired whether the agitation of the milk in travelling destroyed the cream in the milk brought into London?

Mr. BARHAM replied in his opinion the globules would not be destroyed, if the milk were put into the cans at a sufficiently low temperature. He considered milk ought never to be packed at a temperature of more than 60 degrees, and if that were observed the milk would come to London in perfectly good condition. The Express Country Milk Company received milk for two years from Wareham, in Dorsetshire, a distance of 130 miles by rail and seven miles by road. It arrived in fine condition. He attributed this result to the chalky nature of the soil, and to the milk being thoroughly cooled before being packed. It was well known that the milk of cows fed off heavy, clayey land would not keep so long by several hours as that produced on a chalky soil. The agitation of the milk in travelling did not permit the obtaining of cream if it were required. The most favourable time for setting milk for cream was the moment after it came from the cow, or at about 90° Fahr. Dairies in the country were not kept at that temperature, but it was seldom they were so low as 60° Fahr. in the summer, and artificial heat was employed in the winter to maintain that temperature. If the object were to prevent the globules of the milk being destroyed by the shaking, that would be best effected by *completely* filling the cans. The cans at present in use cannot be so completely filled as to prevent agitation. The Express Country Milk Company received ten cans of milk from one dairy every day through the last summer, and there was not a particle of butter in them, though they travelled two miles by road to the station, forty-eight miles by rail to the metropolitan terminus, and three miles by van to the place of business. Some of the cans were only three-parts full, and yet the cream was retained on the milk, although, from being cooled, it would take some hours longer for the cream to rise. The best way of supplying cream in London would be to have it sent in a separate state from the country, as was done to a certain extent at the present time, though on a comparatively small scale. Cream might be supplied, in almost any quantity, daily if the demand were regular, but, as the demand was extremely irregular, beyond doubt there was occasional difficulty in obtaining it. The amount of cream which rose to the surface of the milk when set was rendered less by about 20 per cent. through travelling, that percentage being retained in the milk. He had never used the Devonshire method of getting cream, and he believed it had not been tried in London. The milk which was served in London in the morning would probably have been milked from four to eight hours previously; that supplied in the afternoon was more recently milked. The system of 12 hours milking was generally adopted. The milk supplied to London in the early morning was milked during the night, say from seven p.m. to two a.m., the hour depending upon the time the last train at night or the early mail train called at the country station. The afternoon milk was milked from nine to eleven a.m., and was distributed between two and four o'clock p.m. When cream was sent in a separate state, it was packed solid in bottles prepared for the purpose, and kept cool by grass or cabbage leaves fastened round the bottles.

Mr. TEULON inquired what was the average yield of cream, from milk of good quality, set as soon as it came from the can.

Mr. BARHAM replied it would be about five gills per barn gallon of milk set, from cows fed on good pasture. The same milk in London would probably not yield more than a pint of cream, and would require a much longer time to rise to the surface, owing to the cooling of the milk.

Mr. MICHAEL inquired to what use the milk was put from which the cream was taken.

Mr. BARHAM replied it was sold as skim milk, at 2d. per quart. In some neighbourhoods there might be a demand for skim milk, but it was not generally the case in London, and it would require depôts in the poorer neighbourhoods to do anything like a trade with it. The major portion of the skim or surplus milk was disposed of at a low price to biscuit bakers, who use it in their manufacture in a sour state, when it forms lactic acid. Looking to the fact of the readiness with which milk can be tested by the use of the lactometer and the cream tube combined, it was surprising to him that customers did not more generally test the article they were supplied with, although he believed there was no test by which we could detect the water added by way of dilution from that which was in the milk naturally. He did not think feeding upon grains produced an inferior quality of milk, but such food, being of a stimulating nature, might increase the quantity of milk. He knew it was the habit of some dairy keepers to drive their cows to water before milk, in order to increase the yield of milk.

In reply to Mr. E. WILSON,

Mr. BARHAM added that he did not think there would ever be a large demand for skim milk in London, even in the poorest districts. The very poor—particularly the Irish poor—were for the most part excellent judges of milk, and what little they bought they preferred to have good. In some neighbourboods diluted milk was sold as new milk at 2½d. to 3d. per quart.

Mr. MICHAEL inquired whether Mr. Barham was able, as a rule, to equalise his supply and demand so as to have but little waste milk?

Mr. BARHAM replied certainly not; but it went to the biscuit bakers' or the pigs. It was the object of the milk dealers to obtain such a customer for surplus milk at a low price, or else it would be all wasted.

The CHAIRMAN inquired if it were the fact that there had been a considerable diminution in the number of London cow sheds since the late epidemic.

Mr. BARHAM replied in the affirmative. The medical officers of health had reported so frequently of the unhealthiness of localities where cows were kept, that magistrates would not grant any licences in particular districts. St. James's and St. Clement Danes were two instances, and in other districts it was well known that no new licence would be granted, nor an old one renewed, except upon proof of great cleanliness, space, &c. Many cowkeepers had had severe losses from disease, and were afraid to keep cows in London; and the sheds formerly occupied in that way were employed as stables for other purposes. Some of the London cowkeepers had farms out of town, and sent their milk by railway. He was decidedly favourable to the entire abolition of cow sheds in London, although he believed it was the opinion of some dealers that the presence of cows promoted their business.

Mr. MICHAEL, reverting to the subject of the cans, inquired whether Mr. Barham considered there was any great advantage in the large cans, with the exception of the facility for rolling them from place to place?

Mr. BARHAM replied that the question of the return of the empty cans must be regarded, inasmuch as the railway companies charged as much for a small can as for a large one. He thought the transit was facilitated by the use of the large cans. In respect of the effects produced upon the milk itself, he did not know that the large cans gave any advantage over small ones. If suitable arrangements were made for the conveyance of small cans, he thought the large ones might be dispensed with; and in the event of milk being packed in a warm state, it might be advisable to send it in smaller bulks; but, if it were cooler than the atmosphere, the larger the bulk the better.

Mr. MICHAEL remarked that, during the six cool months of the year, there would be no danger of the formation of lactic acid.

Mr. BARHAM concurred in that, and added that the air which was admitted through the holes in the lid of the can was not always sufficient in hot weather to keep the milk sweet. He had not tried the experiment of hermetically sealing the cans when completely filled, and excluding all air, nor was he able to give an opinion on that point. At present fully half the milk that was sent to London in small quantities came in cans that were not full. The Parisian milk was generally acknowledged to keep longer than that supplied to London; this had been attributed to its being hermetically closed while travelling; but an old Parisian dairyman had let him into the real secret, and that was they mixed bicarbonate of soda with their milk.

Mr. E. WILSON incidentally remarked upon the general scarcity of cream at the tables of persons in London who lived in the most luxurious style. He thought there was no good reason for this. Visitors from London to the country regarded cream as an article wholly beyond their reach.

Mr. BARHAM said if a daily supply were ordered by families, cream could be had in any quantity. It was owing to the uncertain nature of the demand that so little cream was sent to London. The retail price of four shillings per quart for cream made it about equal to that of a barn gallon of milk at the retail price, allowing eightpence for the skim milk.

Mr. E. WILSON asked whether Mr. Barham had considered the question of the different breeds of cows in reference to the quality of the milk when tested by the lactometer and cream tube?

Mr. BARHAM replied that he had done so to some extent. It did not much affect the specific gravity of the milk, but it bore upon the percentage of cream. For example, the specific gravity of cream was less than that of milk, but the richer milk was in cream, the larger quantity of the element caseine it contained, which, being heavier than either, the specific gravity of poor and rich milk was nearly the same.

Mr. MICHAEL remarked that the conclusion to be drawn was, that neither the lactometer nor the cream tube was a satisfactory test of the quality of milk, but that it required scientific investigation beyond that.

Mr. BARHAM said the standpoint varied from 1030 to 1034 of specific gravity, and there should be at least 8 per cent of cream.

Mr. MICHAEL observed that it was easy to apparently increase that percentage by simple artificial means.

Mr. BARHAM thought it would be too expensive, and people did not generally adulterate with ingredients more costly than the article to be adulterated.

In the course of some general observations made by Mr. Barham, he stated his opinion that London was better supplied with milk now than it had been at any previous period in his recollection, although he thought it could be greatly improved by the total abolition of the London cowsheds, and the use of properly-constructed railway vans for the conveyance of country milk. The London cowkeepers did not now, and probably never did, study the quality of the milk their cows give. The retail dealer and distributor, in obtaining his daily supplies, made an arrangement to milk the cows himself, and to pay a certain sum per gallon,—thus he defeated any direct attempt at adulteration; but as the cowkeeper's object was quantity not quality, he adopted every means of stimulating the secretion of milk in the animal, by the manner of feeding and keeping it, and by those means deteriorated the quality and wholesomeness of the article. Now, on the contrary, three-fourths of the present supply was obtained from the farms of noblemen, gentlemen, and farmers of repute, who take great pride in the breed and condition of their stock, and in the quality of the milk their cows yield. Mr. Barham further said that the Express Country Milk Company, of which he is the manager, derive a large portion of their supply from the home farms of the Earl of Macclesfield, at Shirburn Castle, Lord Monson, at Gatton Park, and Lord Lytton, at Knebworth.

Referring to the necessity of improved railway vans being used in the transmission of milk to the metropolis, Mr. Barham said that, in their present mode of conveyance, the railway companies were open to grave rebuke. Notwithstanding they charged 13 per cent. on the prime cost of the article for carriage, their manner of conveying it was simply abominable, not to say offensive. It is frequently put into the guard's van, and had baskets of fish, water-cress, and other material placed upon it, which were permitted to drain and drip through the perforated top of the cans and mix with the milk. He related an instance within his own experience, of a leaky can or bottle containing naphtha being placed on a milk-can, which, draining into the latter, totally spoilt 70 quarts of milk. He quoted other and similar instances of the neglect of railway companies as carriers of milk from country districts, notably, their custom of placing the cans in open trucks, exposing them in the summer time to the scorching rays of the sun attracted by the tin, and in the winter to heavy rains and snow, and at all times to the soot and coke drift from the furnace of the engine. Not unfrequently, continued Mr. Barham, the cans are placed in horse boxes, from which horses have just been removed, and in the summer season the smell in these boxes is most offensive.

The Committee thanked Mr. Barham for his attendance and the information he had given, and then adjourned.

CANTOR LECTURES.

The first lecture of Mr. W. H. Perkin's course "On the Aniline or Coal Tar Colours," was delivered on Monday evening, the 7th inst. A full report of these lectures will appear in the *Journal* at an early opportunity.

FOURTH ORDINARY MEETING.

Wednesday, December 9th, 1868; Professor W. ALLEN MILLER, F.R.S., of King's College, London, in the chair.

The following candidates were proposed for election as members of the Society :—

Fison, E. Herbert, Stoke-hill, Ipswich.
Marchisio, Dr. J. E., 50, Baker-street, Portman-sq., W.
Stallard, J. H., M.D., 7, King's-rd., Bedford-row, W.C.
Sullivan, Thomas Durell, 56th Regiment.
Taylor, Edward James, Shawfield-street, King's-road, Chelsea, S.W.

The following candidates were balloted for, and duly elected members in the Society :—

Huggins, Henry, Gordon-house, Kentish-town, N.W.
Rönn, Hermann S. Von, 21, Kensington-park-grdns, W.
Sadgrove, Archer W., Ellerslie, Eltham-road, Kent.

The Paper read was—

ON THE DRYING PROPERTIES OF VARIOUS KINDS OF HOUSE PAINT.

By CHARLES TOMLINSON, F.R.S., F.C.S., &c.

I owe an apology to this meeting for having been compelled to substitute for the subject originally announced, another, which, I hope, will not be without interest. When, some months ago, your excellent secretary asked me to prepare a paper for to-night, I thought the scientific details connected with boiling liquids would have been already discussed elsewhere so that I could have had the honour of submitting the practical results to your notice. I still hope to do so if your Council will give me an evening after Christmas.

The question we have to consider to-night is, "Why does paint dry?"

The difficulties of this question presented themselves to me on the occasion of some house-painting during the last summer. "Capital weather for drying, sir!" was the remark of the painter. "Why does paint dry?" was the question of a child.

I have great love and respect for children. I love them because they think what they say, and say what they think. I respect them because they are good observers, and continue to be so until they go to school and learn how not to observe. Philosophers are children whose powers of observation have been cultivated. Children, left to themselves, are philosophers. What a pity they should cease to be so.

But why does paint dry? When a shower of rain wets the pavement and the sun shines out and the wet disappears, we know that a certain amount of heat-force has converted the water into invisible vapour, and we call this process of drying, evaporation. So also when we boil a kettle of water there is a change of state, of water into steam, and a process of evaporation is going on, only in this case it is more rapid than in the other, and evaporation is not superficial merely, but from every part of the liquid, more or less. Continue the process, and the water dries up by this rapid evaporation. Again, if we apply heat to oil of turpentine contained in a retort, it will boil at a little over 300° F., and the vapour may be collected and condensed in a cooled receiver. But if we try to boil linseed oil, for example, it will not only not distil over, but it will blacken and decompose instead. If we moderate the heat so as not to carbonise it, then it will lose about one-sixth of its weight and become thick, tenacious, and viscid; forming what is called printer's varnish. Raise the temperature above 600°, and if air be present the oil will take fire and burn quietly without further external heating until nothing but tar or charcoal is left. If, however, the burning be interrupted by closing the vessel, a brown viscid substance will be left, known as bird-lime.

There must be something, then, very different in the constitution of these two oils, turpentine and linseed, since they behave so differently under the influence of heat. Such is the case. Turpentine belongs to a class of oils known as *volatile;* that is, they can be raised into vapour by means of heat, and, under certain conditions, will evaporate, or dry up, in the sense that the wet on the pavement dries up after a shower of rain. Linseed oil, on the other hand, which cannot be boiled or distilled, belongs to a class of oils called *fixed*.

Some one now steps in with an objection. Painters not only boil their linseed oil, but the very process gives the name of *boiled oil* to the product.

What painters really do is this:—They gradually raise the oil to about 500°, when it begins to give off acrid vapours, and a little above 600° the oil itself begins to decompose with the escape of gaseous hydro-carbons, which, swelling up in bubbles, give the oil the appearance of boiling. Continue the process out of the reach of air, and the oil would be entirely broken up, past recall, into a mixture of solid and liquid hydro-carbons, and various fatty acids, with a very irritating body, known as *acrolein*, from its distressing action on the mucous membrane of the eyes and organs of respiration. It is quite clear, then, that the linseed or nut-oil used as the liquid vehicle of paint does not dry by the ordinary process of evaporation. I put the question, "Why does paint dry?" to an intelligent painter, and the answer was, "Because we mix *dryers* with the paint." These dryers, as they are called, consist of litharge, oxide of manganese, and sugar of lead. Linseed oil is heated with about one-twentieth of its weight of litharge, which the oil completely dissolves, and is then used as a dryer. A similar heating with manganese or sugar of lead also improves the so-called drying properties of the oil.

But what would be the effect of omitting the dryers altogether in the composition of the paint? I have no doubt most painters would say that the paint would never dry. Let us see the result of a careful experiment performed by Chevreul some years ago. Of course, you are aware that house paint, omitting the colouring matters or stainers, consists of three ingredients:—1st, white lead or white zinc; 2nd, a fixed oil, such as linseed, or nut, used for the purpose of reducing the white to a soft paste, to which are afterwards added variable proportions of linseed or other oil for thinning the paint; 3rd, the drying material or dryer which we now propose to omit.

Four oak strips were painted, each on one side, with a paint composed of white lead and linseed oil, and on the other side with a paint composed of white zinc and linseed oil. The strip No. 1 was exposed to the air to dry; No. 2 was put into a bottle of the capacity of two litres (3·52 pints) and closed; No. 3 was put into a similar bottle, containing dry oxygen gas; No. 4 was put into a similar bottle, containing dry carbonic acid gas. The results as to drying were examined after twenty-four hours, and again after seventy-two hours:—

After twenty-four hours.

No. 1. The lead paint was almost dry; the zinc paint had set, but was not dry. No. 2. The lead paint was almost dry; the zinc paint had set, but was not dry. No. 3. Both the lead and the zinc paints were perfectly dry. No. 4. Both paints were still wet and fresh, and had undergone no change.

After seventy-two hours.

Nos. 1 and 2. Both paints were perfectly dry. No. 4. The lead paint had almost set, but it had no adhesion to the wood, and could be easily removed by friction; the zinc paint had undergone no change, but stuck to the finger like fresh paint.

Now, how remarkable are these results. Paint, containing no so-called dryer, dries rapidly and completely in oxygen gas, within twenty-four hours, and does not dry at all in dry carbonic acid gas. It dries more slowly in the air, whether exposed or confined, and in another experiment it was shown that in drying in a confined volume of atmospheric air, the paint had absorbed all the oxygen, and left nothing but pure nitrogen in the bottle.

We can now answer the question, "Why does paint dry?" in a scientific, that is, in a satisfactory manner. Paint dries, not because it loses anything, as in the case of ordinary drying by evaporation, but because it absorbs oxygen from the air, and solidifies in combining with it. The drying of paint is not, therefore, a physical effect, as in the case of evaporation, but a chemical one, in which there is a change of properties attending a change of state from liquid or viscid to solid.

In the above experiments we omitted the dryers; what would be the effect if we left out the white lead or the white zinc, and exposed pure linseed oil to the air?

Linseed oil exposed to the air in thin layers dries up into the form of a resinous, transparent, moderately elastic mass resembling caoutchouc. This property of absorbing oxygen and gradually becoming solid, also applies to walnut, hemp, poppy, grapeseed, safflower, and some other oils, and hence such oils are termed drying oils. In undergoing this change these oils undergo slow combustion, and give off carbonic acid. Under certain conditions the drying oils absorb oxygen so quickly as to take fire, as when the cotton-wool, tow, &c., used in cleaning machinery is thrown aside, and has thus led to conflagrations.

The non-drying oils, or those that do not absorb oxygen, are rape, colza, olive, almond, and many animal oils. By exposure to air they become gradually changed, but in a different manner as compared with drying oils. They become rancid from the fermentation of the cellular substances of the plant or animal from which the oil was obtained. They lose their colour, and, to a certain extent, their fluidity, and acquire an acrid, disagreeable taste. Such oils are of course quite unfit for the purposes of the painter, although there is ground for suspicion that linseed oil is sometimes adulterated with a cheap fish oil, the result of which in the paint is to produce a disagreeable kind of stickiness which is all but permanent. While studying the cohesion figures of liquids some years ago, I was anxious to procure a specimen of pure linseed oil. The specimens procured from oil warehouses gave different figures; but in the International Exhibition of 1862, there was a linseed-oil press at work. Here, I thought, is a splendid opportunity for getting a specimen of pure linseed oil. "It must be pure," said the man, "for we make it before your face." He gave me a bottle of oil, and generously volunteered to give also a sample of the seed. To my surprise, on examining the linseed, I found it mixed with various other seeds to the extent of at least one-sixth. What hope, then, is there of obtaining pure linseed oil, and, consequently, good drying paint, if not only the oil is liable to adulteration, but the source of the oil itself is impure.

The distinguished chemist who does us the honour of taking the chair to-night, has been good enough to place at my disposal some recent results obtained by the Dutch chemist, Mulder, who drew some of the oils experimented on from good fresh seed in his own laboratory. According to Mulder, the difference between non-drying and drying oils arises from the presence of oleic acid in the latter. He compares drying oils to blood; they absorb oxygen and give off carbonic anhydride (commonly known as carbonic acid). To prove this in the case of linseed oil, fragments of pumice stone were ignited, left to cool, and then put into a bottle, and the pumice was moistened with boiled linseed oil, the effect of boiling being to raise the oil into a state of greater activity. Air, previously deprived of carbonic anhydride, was next passed over the pumice, and then into a vessel containing baryta water, which, in a few minutes became turbid from the presence of carbonic acid, due to the slow combustion of the oil.

A pure linseed oil, drawn in the laboratory, was represented by the formula C 76·8 H 11·2 O 12. When made colourless by being passed through animal charcoal, its composition was not altered. Poppy oil, nut and hemp seed oil, were found to be similar in composition. The chief component of these oils, and probably of all drying oils, is a neutral fat known as linoleine. Linseed oil also contains the fatty bodies known as elaine, palmitine, and myristene. Poppy oil contains elaine, myristene, and laurine. Walnut the same, but rather less laurine. The mucilaginous matter said to exist in these oils, and to act as a ferment, was not found.

The ash of good linseed oil was found to contain only one per cent. by weight of the oil burned.

In the so-called dry distillation of linseed oil, when carefully conducted, decomposition begins at 250° C (482° Fahr.); it yields acroleine, which, by partial oxidation, forms a certain quantity of acrylic acid, sebacylic acid, palmitinic acid, and myristinic acid, while the great bulk of the oil left in the retort is the anhydride of linoleic acid not unlike birdlime, or fused india-rubber. It is insoluble in ether. It is dark-coloured in the mass, but of a straw-yellow in thin layers, and very elastic. This is the basis of our printing inks. In preparing it, in practice, there is usually a great loss, from the application of too strong a heat, so that volatile hydro-carbons and even oil-gas are produced.

Linseed-oil, by saponification, yields glycerine, linoleic acid, elainic acid, palmitinic acid, and myristinic acid.

100 parts, by weight, of several drying oils, yielded by saponification from 87·7 to 95·4 parts of fatty acids, dried at 100° C. Fresh linseed-oil 95·4 parts, old walnut oils 87·7 parts.

Linoleine is readily saponified by means of a solution of basic acetate of lead, the effect being the same as boiling the oil with litharge, or red lead.

Pure linoleine is not disposed to become rancid. The drying oils become slowly rancid by changes produced in the other fatty bodies present, especially in the elaine.

Poppy and nut oils become much sooner rancid than linseed oil, but in general, the drying oils become less rapidly rancid than the non-drying.

The acid compound of linoleine is linoleic acid. This is a colourless compound when pure, and it is very fluid at 14° C., and is not solidified at—18° C. Its specific gravity is 0·9206. It reddens litmus, and is soluble in alcohol and ether. When exposed to air in thin layers linoleic acid absorbs oxygen and turns red. This change is greatly promoted by the presence of bases. The lime and baryta salts of linoleic acid are soluble in boiling alcohol. The lime, zinc, copper, and lead salts are soluble in ether. The acid readily oxidises, yielding linoxic acid, a substance something like Venice turpentine; it is colourless, but becomes blood red by being exposed to the heat of boiling water, as also by contact with strong caustic alkalies and acids. The alkaline carbonates do not affect this acid in the same way. The change in colour is not accompanied by change in composition.

In the change produced by the exposure of linoleic acid to the air, a body known as linoxine is first formed, and some months elapse before the peculiar stickiness of the Venice turpentine-like body is formed. With raw linseed oil, however, the change takes place in about two weeks, with boiled oil in a few days. Linoxine is formed by the loss of one equivalent of the elements of water from linoxic acid. Linoxine is an important body, it being the chief compound resulting from the application of oil colours and paints. It is amorphous and somewhat elastic, like leather or gutta-percha. It is not hygroscopic. It is heavier than water, and is not soluble in water, alcohol, or ether; it swells up in chloroform and bisulphide of carbon; it is not affected by acetic acid or by dilute mineral acids. Caustic alkalies dissolve it and turn it red, and it is precipitated from those solutions without change. The best solvent for linoxine is a mixture of chloroform and strong spirits of wine, aided by a moderate heat. Oil of turpentine renders it gelatinous, but does not dissolve it. It is not affected by being raised to 100° C., only it gets a little darker. It cannot be fused without decomposition.

Such are Mulder's results, very briefly stated. They ought to have a marked effect not only on the practice of the house-painter, but also on that of the printer's ink maker. Chevreul's details also are full of practical instruction, and we now proceed to lay them before you.

Roughly speaking, the setting of paint is due to the absorption of oxygen; hence we can understand why painters, in order to prevent their brushes from getting hard, put them into water when they leave off work; and also cover a painted surface with water when they want to keep the paint from setting.

We have spoken of white lead, or white zinc, as the basis of paint; white antimony has also been proposed. In order to determine the relative merits of the three M. Chevreul instituted an experiment, in which 10 grammes (154 grains) of pure linseed oil were mixed up with sufficient quantities of the three solids without the addition of any dryer. It was found that the zinc paint covered a less surface than the lead, but more than the antimony paint. The drying of the different coats of these paints required very different times, as will be seen in the following table:—

Coats.	Lead Paint.	Zinc Paint.	Antimony Paint.
	days.	days.	days.
First	4	18	50
Second	3½	15	28
Third	3	5	27
Total	10½	38	105

Hence it appears that lead paint dries much more quickly than zinc or antimony paint. Indeed, unless it were possible to hasten the drying of zinc paint by the addition of a dryer, zinc paint would be of very little use in industry, since the practice of house painting requires that not more than two or three days shall elapse between the application of the first coat and that of the second.

Antimony paint is also too slow in drying to be used. A tin paint was also tried, but the oxide of tin was found to delay the drying of the oil. Pure linseed oil dries more quickly on glass than when mixed with oxide of antimony, so that this oxide is actually anti-siccative relatively to glass.

We now come to the dryers, such as litharge, manganese, &c., and their action is very remarkable in causing the paint to absorb oxygen quickly and decidedly. For example—two cubic centimètres of linseed oil absorbed, in 30 days, 2·445c.c. of oxygen; but the same quantity of manganese dryer absorbed 21·45c.c. of oxygen; while a mixture of the two, consisting of 1·56c.c. of linseed and 0·44 of the dryer absorbed 30·826c.c. of oxygen. That is, the absorptive, or, as a painter would say, the *drying* power of the mixture is far greater than the sum of the powers of the two substances, since 1·56c.c. of linseed oil absorbs of itself 1·985c.c. of oxygen, and 0·44 of the manganese dryer 4·719c.c. of oxygen in 30 days, the sum of the two absorptions being 6·714c.c. But the mixture really absorbed 30·826c.c., or more than four-and-a-half times as much as the same fluids absorbed when exposed separately.

Experiments, scientifically conducted, have also shown, that in preparing his dryers, the painter wastes both good materials, fuel, and time. He boils his oil too long, and maintains the temperature too high.

The usual mode of preparing dryers is to heat the linseed oil in an iron pot until it appears to boil. The surface is skimmed from time to time, and after from three to six hours, about one-tenth, by weight, of litharge is added, and the heat is maintained five or six hours longer; or 100 parts of very old linseed oil are heated about six hours, when six parts of litharge, and about three of burnt umber are added. The heat is continued six hours longer, when the liquid, after being left quietly to cool, is decanted. For the manganese dryer, the oil is heated at the so-called boiling point during five hours; peroxide of manganese is thrown in, and the boiling continued for eight hours. We have already seen that the boiling is not the formation of vapour, but the escape of gas-bubbles due to decomposition.

Chevreul's experiments prove that pure linseed oil is more siccative after three hours' boiling than if not boiled at all; but it is less siccative after five hours' boiling than after three. The oil boiled during three hours with one-tenth of litharge is much more siccative than if heated without the addition of this oxide, so that the drying property is not conferred on the oil by the action of heat, as some have supposed, but it is by the mutual action of the oxide and of the oil, assisted by a high temperature, that the drying properties are developed. Litharge is more siccative than manganese; and what is very curious is, that litharge, heated once with oil, is more active than fresh litharge. It is still more curious, that manganese that has been heated several times with the oil is more active than fresh manganese. But this excess of activity in the oxides is no longer exerted on oil that has already been boiled five hours. All the experiments proved that the drying property of linseed was injured by a prolonged heating at high temperatures; and the remarkable and unexpected result came out, that linseed, exposed to the temperature of from 100° to 176° Fah. during six hours in contact with ten per cent. of manganese, can be used immediately in painting without the addition of any other dryer. Linseed oil alone, exposed to a similar moderate temperature, improves in its siccative property, but not sufficiently so to dispense with the manganese. A very energetic dryer is obtained by boiling the oil for three hours only in contact with fifteen per cent. of the metallic oxide.

Everyone knows what is expected of good paint. In the first place it should be sufficiently liquid to spread under the brush, and sufficiently viscous to adhere to the surface, even though it be vertical, without running, or becoming unequally thick in different places. In the second place, it should become solid within a reasonable time after being applied; thirdly, the solid should adhere strongly to the surface.

We have seen that lead and zinc paints become solid by the absorption of atmospheric oxygen. But as pure linseed oil also becomes solid by exposure to the air, the drying of the paint is not due to the presence of a dryer, or of the oxide of lead or of zinc. It is true that the dryer acts by increasing the absorptive power of the oil for oxygen gas. The lead and zinc oxides have also drying properties, and we must not neglect the influence of the surfaces that are to be painted. Paint dries at different rates on glass, wood, and metal; it dries better on some kinds of wood or of metal than on others, of course under similar conditions of experiment.

Take glass, for example. Surfaces of glass were coated with linseed oil, also with the oil containing a little white antimony, and with the same compound with the addition of a little litharge. The linseed dried quickly, the antimony compound not so quickly, while in the third compound the presence of the litharge seemed to neutralise the retarding effect of the antimony. The following table shows the results:—

	Linseed oil.	Linseed oil and oxide antimony.	Linseed oil and litharge dryer and oxide antimony.
	days.	days.	days.
First coat dried in	17	26	21
Second ,, ,, ...	17	8	9
Third ,, ,, ...	9	9	2
Total..........	43	43	32

It appears from this table—1. That a glass surface does not allow the paints to solidify so readily as a surface formed of the solid oil or paint. 2. That the antimony oxide is anti-siccative, which effect is corrected by the litharge. 3. That in the second coat the glass seems to be still exerting a retarding action on the oil, but this is not so evident in the antimony paint. 4. That the influence of the litharge dryer is evident in reducing the time required for the drying of the third coat. This influence seems to depend not only on the presence of the litharge dryer in the viscid paint, but also on its presence in the solid surface on which the fresh paint is laid.

The influence of the kind of surface employed on the drying of paint is well shown in the case of oak. On oak surfaces stained brown, three coats of linseed oil took 46 days to dry, oil with a litharge dryer 7 days, oil with a manganese dryer still less time. It was also found that linseed oil and white lead, and linseed oil and white zinc dried more quickly with a manganese dryer than with a litharge dryer. On a surface of clean oak the first coat of oil took a very long time in drying. On the twenty-second day it was soft and pasty beneath the surface; the oil had sunk into the pores of the wood, and thus prevented it from absorbing the oxygen required for its solidification. This explains why oil dries more quickly on a painted wooden surface than on a porous one. On a porous surface the dryers seem to act with great effect, probably from covering the wood and preventing the oil from sinking into the pores. Their influence is shown in the following table:—

	Linseed oil and white zinc.	Linseed oil and litharge dryer and white zinc.	Linseed oil and manganese dryer and white zinc.
	days.	days.	days.
First coat dried in	66	6	5
Second „ „	6	5	3
Third „ „	6	5	3
Total..........	78	16	11

This also shows that a surface of linseed and white zinc allows the paint to dry much more rapidly than a surface of porous wood does. A similar effect is produced when the paint is laid on an old surface of paint. The paint itself also becomes more siccative under the influence of time and atmospheric exposure.

It appears from experiment that paint dries more quickly on poplar than on oak, and more quickly on pine than on poplar. In the experiments on metallic surfaces the most remarkable results were obtained on lead. The first coat of linseed oil dried very quickly on this, as also the first coats of lead paint and of zinc paint. The zinc paint dried first, then the linseed oil, and lastly the lead paint. The zinc paint, however, tended to retard the drying of the subsequent coats. A newly-scraped surface of lead acted more energetically than one that had been tarnished by exposure to the air, but the lead covered with one coat lost its influence in hastening the drying of the subsequent coats. The first coat of oil on bright lead was only ten hours in drying. In short, we get this remarkable result, that lead is siccative with reference to pure linseed oil, while white lead itself, a siccative body, is anti-siccative with respect to linseed on metallic lead. The influence of various metallic, vitreous and wooden surfaces is thus summed up by M. Chevreul:—

First Coat.

On Copper.—Oil dried more slowly than both oil and white lead, and oil and white zinc.

On Brass wire and Zinc.—Oil dried as rapidly as oil and white lead, but more rapidly than oil and white zinc; but on the brass wire the drying was more rapid than on zinc.

On Iron.—Same results as on zinc; but oil and white zinc dried more quickly on iron than on zinc. This is analogous to the fact noticed with lead. The oil and white lead dried more slowly on lead than did the oil and white zinc.

On Porcelain and Glass.—Oil dried a liftle more quickly than oil and white zinc, and oil and white lead a little more quickly still.

On Plaster.—The oil and white zinc paint dried in about equal times.

On Poplar and Mountain Ash.—Oil dried more slowly than oil and white lead, and also than oil and white zinc.

Three Coatings.

On Copper, Brass Wire, Zinc, Iron, Lead.—Oil and white lead dried more quickly than oil and white zinc. This was also the case on porcelain, glass, plaster, poplar, and mountain ash. In the case of the woods, linseed oil was found to dry more quickly on ash than on poplar, and more quickly on poplar than on oak.

Some of these surfaces may, however, be regarded as indifferent, as respects their influence in quickening or retarding the drying of paint; but the temperature and other circumstances modify any general conclusions that may be drawn on the subject. Paint dries more quickly at from 77° to 82° Fah., than from 59° to 64° Fah., other things being equal. This explains why, in practice, the proportion of dryer varies with the temperature. In winter it is customary to add from three to nine, and even ten per cent. of dryer to the linseed; in summer not more than half, one and a-half, or two per cent., and it may even be left out altogether in the last coat. The drying property of linseed oil is nearly always increased by the addition of white-lead, and in most cases by that of white zinc. If the compound be not sufficiently siccative, it can be made so by the addition of a dryer, whether of litharge or of manganese, due respect being paid to the varying conditions of the surface, number of the coats, whether first, second, or third, the temperature of the air, and the amount of natural light present.

But the influence of the lead or manganese dryer, as will be gathered from the foregoing details, is not so important as is generally imagined. It can be dispensed with in the second and third coats, and even in the first if the temperature of the air be favourable. Linseed oil by exposure to light and air loses its yellow colour and becomes siccative, so that it can be employed alone with white-lead or white zinc without detriment to their purity. If white zinc be associated with the sub-carbonate of zinc, the drier may be dispensed with altogether.

Paint owes its lustre and smoothness to the oil alone. If oleic acid were mixed with metallic oxides in such proportions as to form solid chemical compounds, and the acid were to pass quickly from the liquid to the solid state, the result would not be a smooth, uniform, oleate; but when the drying oil passes slowly into the solid state, in consequence of the gradual absorption of oxygen, and the changes pointed out by Mulder, the very slowness of the process allows the oily molecules to arrange themselves into a symmetrical compound, which would be transparent were it not for the opaque particles of the white-lead imprisoned in the compound. If these opaque particles are not in excess, the molecular arrangement is such that the paint dries into a surface that is lustrous, and even brilliant, in consequence of the mirror-like reflection of the solidified oil.

No notice has yet been taken of the action of the turpentine, which is added by painters in order to diminish the viscosity of the paint, and to allow it to spread more easily under the brush. If the surface is to be polished, a large proportion of turpentine is used; if it is to be varnished, as much turpentine is added as will render the paint very fluid, but not too fluid to work with; if the paint is to be very durable, and is to be neither polished nor varnished, only a small proportion of turpentine is to be added. As turpentine dries to a great extent by evaporation, one of its chief uses is to hasten the drying of paint. Thus, three layers of linseed oil on glass dried in twenty-five days; but when about thirty per cent. of turpentine was added to the oil the mixture dried in twenty days. This drying effect is promoted by a previous exposure of the turpentine to the air. When both oil and turpentine have been previously exposed, the drying takes place still more quickly. Exposure to air has a similar influence on the other ingredients of paint, even on the white zinc.

This exposure in the case of turpentine favours the combination with atmospheric oxygen and the consequent resinification of the liquid. Exposure in the case of a porous body like white zinc may also lead to the physical absorption of oxygen, and thus hasten the drying. If this physical effect were really obtained in the case of white zinc and white lead, Chevreul thought it likely that the presence of other solid bodies in the paint might have a similar effect. But before putting them into the paint, their influence as surfaces was tested. When linseed oil was laid on white lead three coats dried in seven days; but on sulphate of zinc they occupied eighteen days in drying, twelve being required for the first coat and two for the second; white lead is therefore more siccative than the zinco-sulphate. In both cases the first coat acted as a dryer to the second. When a mixture of sulphate of lead and white lead was used as the surface, the oil dried almost as quickly as on white lead alone. It has already been shown that the addition of the litharge and manganese dryers made the linseed oil dry more quickly, that is, it became more capable of absorbing oxygen from the air. It is remarkable that this absorptive power is increased by the addition of solid bodies such as sand. Linseed oil mixed with white lead dries more quickly than the oil alone, so that white lead is a dryer or siccative. Oil mixed with sulphate of lead dries very slowly; but a mixture of oil, sulphate of lead and white lead dries as quickly as oil mixed with white lead only. Hence the presence of white lead confers extra drying power on sulphate of lead. Carbonate of zinc acts as a dryer, when added to oil or white zinc; and the mixture dries more quickly than oil mixed with white zinc only. Oil mixed with zinc carbonate sets more rapidly than with zinc white; but it forms a semi-transparent, not an opaque paint. As zinc carbonate renders oil and white zinc more siccative, it might be substituted for the manganese dryer, which has the disadvantage of imparting colour to zinc white. Two paints were prepared, one consisting of 100 lbs. of linseed oil, 75 lbs. of zinc white, and 25 lbs. of zinc carbonate; the other of 98 lbs. of the oil, 2 lbs. of manganese dryer, and 100 lbs. of white zinc. With each of these paints a door was painted. Four hours after they had been applied both paints appeared to be equally set; but the surface coated with the first paint was whiter than that coated by the second, the whiter paint was, however, the less adherent.

In conclusion, I venture to think that the question, "Why does paint dry?" has been fully answered, and that the intelligent house painter will find, in the details thus brought together, some material for the improvement of his useful art. The only object of science is the discovery of truth; but the truths of science form a rich resource for the technologist. He finds in them the only proper basis for real improvement; and the Society of Arts is, I think, never better employed than when it brings the man of scientific theory into direct contact with the intelligent man of practice. The time is happily passed away for ever when the so-called practical man boasted of his independence of all theory. He now knows that, by such a self-imposed blindness, he placed himself at least half-a-century behind the intellect of his age. Every art that depends on chemistry seeks the aid of science; and in working out technical results on a large scale scientific truth is often assisted; just as, by the same righteous law of reflex action, the results produced on a small scale in the laboratory, apparently for the benefit of science alone, are often reproduced on a large scale in the factory to the advantage and profit of the whole community. I repeat, that the Society of Arts can never be better employed than in acting as the medium of communication between the man of theory and the man of practice.

DISCUSSION.

Mr. Laing said he was familiar with the names of several of the dryers mentioned by Mr. Tomlinson, but he was not acquainted with manganese, which he should like to hear a little more about, as a good dryer was greatly needed in the painting trade, in which he had been engaged for about forty-five years. As regarded the oils used for paints, linseed was the only one which appeared really fit for the purpose, although various other oils had been introduced into the mercantile world. Linseed was naturally a good drying oil, and by the introduction of various dryers, according to circumstances, they were able to produce a paint which would even dry in five or six hours. There were practical differences which a painter had to contend with, connected with the atmosphere, temperature, &c., which rendered it by no means easy to form a correct theory upon the subject. Copperas was a very good ordinary dryer, but for special circumstances they had to heat it with whitening over a fierce fire, and this produced what was called "burnt copperas," and it had to be ground up immediately with the paint, or it would become worthless, from contact with the atmosphere. When paint was properly prepared with it, however, it would dry in two or three hours. Some years ago it was found that oils were very extensively tampered with, sulphuric acid being introduced in order to produce an effect on the colour; and the consequence was that the paint prepared with such oil never became hard, and it could easily be rubbed off. He thought all in the trade must feel greatly indebted to the gentleman who had given them so interesting a paper, but the great desideratum was a good dryer, which would enable them to prepare paints that would dry quickly, and so avoid the annoyance which was now constantly arising from paint remaining long wet. Some short time ago a patent dryer had been introduced, which he believed was a combination of copperas and lime, but, unfortunately, it affected the colour of any paint to which it was applied. Sugar of lead was the only pure dryer he was acquainted with; red lead and litharge would affect almost any colour.

Mr. P. L. Simmonds said he did not quite agree in all that had fallen from the last speaker. There was little doubt that as demand was created, and the wants of commerce became known, some new drying oil other than linseed would be obtained. The researches of the chemist would come in to the aid of the arts. The subject which his friend Mr. Tomlinson had so ably introduced to their notice was one of very great importance, nationally and commercially, for the use of paint was not limited to dwellings, it was also largely in demand for out-door purposes, for vehicles, structural edifices of all kinds, bridges, railways, &c., and also for our extensive mercantile and royal marine—all civilized nations shared in the requirements. The subject had been recently brought very prominently before his notice when acting as a juror at the Havre Maritime Exhibition, on the class which comprised oils, varnishes, paints, and anti-fouling compositions for ships' bottoms, &c. The examination of oils and paints there occupied the long and serious attention of the scientific men on the jury, and the comparative merits of those in use in different countries were much discussed. All who had experienced the inconveniences of a newly-painted house (and who had not?) were interested in the drying properties of paints and their composition, purity, and durability, and the rapid drying properties of the oils with which they were mixed were of great importance. The trade in paints and oils in this country alone was an enormous one, and any investigations or scientific researches calculated to improve their character and guarantee their purity would be most valuable both to the trade and to the public. The Society of Arts had always been foremost in these investigations, and had already done much good by the inquiries it had set on foot and the experiments it had stimulated. Now that iron was so much used, paint-coatings, or compositions calculated to protect the surface, were more in demand, and, with so many iron ships afloat, effective anti-fouling compositions for ships' bottoms were eagerly sought for. There had been many tried, but he believed none were yet found effectual, as the requirements were that the composition should not form a glaze on the metal, but rather a shiny surface, which would prevent the adherence of weeds and barnacles, those great clogs to speed. A friend of his, Dr. Marchisio, had invented an anti-galvanic composition of this kind, which was highly reported on at Havre after careful chemical analysis. When it was considered that vessels had to be painted about twice a year, the importance of any economy effected would be seen. Our Royal Navy required a black paint, as ships of war did not go forth in the coloured paints which merchantmen adopted, and there was some difficulty in getting a mineral base for such a paint. However, this was but a question of time.

Mr. Childs said the affinity of some bodies for oil had been explained in the paper, but he did not think that all the phenomena connected with the drying of paints were to be thus accounted for. The rapidity with which paint dried upon lead might be explained by the fact that oxide of lead, commonly called litharge, had a great affinity for oil, and the presence of the metallic lead facilitated the chemical reaction involved in the drying. Linseed oil, under some circumstances, had a tendency to turn what painters called "fatty," which condition was supposed to arise from age, and the absorption of oxygen from the air; but when it was in this state it did not dry by any means well, therefore, he did not see how the phenomenon of the drying of paint could be accounted for altogether by the absorption of oxygen from the air. White zinc was a very excellent paint for many purposes, but water must not be put upon it, or it became lumpy and hard; and though it might be supposed that this kind of paint would dry as readily in a moist as in a dry atmosphere, this did not prove to be the case. As he had before remarked, he did not think the whole matter was explained by saying that the oil absorbed oxygen from the air; he believed that, by its combination with other bodies present in the paint, its condition became changed. Oil and white lead dried more readily and formed a harder compound than oil and anything else. This showed that there was something in the combination which affected the result. The white lead used in the trade, however, was invariably mixed with sulphate of barytes, and unfortunately it happened that there was great difficulty in getting good barytes. Some barytes would dry very well when mixed with the paint, but other descriptions would scarcely dry at all. Other kinds, again, would discolour the paint with which they were mixed, showing evidently that there was some other substance present. This matter was now under investigation, and he was able to say that it was ascertained that the adulterating matter was soluble in water. He should be very glad if scientific men would turn their attention to this subject. The firm which he represented (Messrs. Pontifex and Wood) would be most happy to afford all possible facilities for investigation and experiment. Very curious effects were produced by the mixture of different bodies with oil. Many of the ochres mixed with linseed oil dried very rapidly; as much so as any of what were called dryers, but this was not the case with all. He did not think the present analysis of ochres was sufficiently accurate to give a proper idea of their ingredients; but, at any rate, the principal ingredients, when used separately in combination with oil would not dry at all. He believed that a great many of the recent complaints of the bad qualities of paint arose from the fact that the turpentine now in the market was not so good as that in use before the American war. French and mineral turpentine had been used rather extensively, and the consequence was that the paint was complained of. He believed that American turpentine was now coming in again, made from the old trees, for it was a curious circumstance that the turpentine produced from old trees was infinitely better than that made from the young ones. It was the same with regard to oils; oils made from young plants was always deficient in some of the characteristics of that made from the mature and ripe tree. As good old American turpentine was now coming in again, they would probably not have so much outcry about the paint, and the varnish makers, who had also come to grief from the same cause, would be placed in a better position. Zinc paint was not, he believed, very much used in England, although it was in America; but as the zinc required more oil, did not (as Mr. Tomlinson said) spread so far, and cost about the same as lead, he supposed lead would continue to be principally used. Indeed, he did not think they would ever improve much on the materials they now had, although they might on the manner in which they used them, which latter he hoped would be the ultimate effect of the paper he had had the pleasure of hearing.

Mr. Fordred remarked that there was one somewhat important point which had not yet been attended to, and that was the origin of the linseed oil. For many years it had been a matter of considerable difficulty to obtain pure linseed oil. Before the Russian war the oil was much better than it had been since. Before that time the oil was made chiefly from Russian seed, but difficulties then arising in the way of its importation, seed was brought from the East Indies. This was found to yield the oil much more freely, but painters objected to it, and said it did not dry so freely by a good deal as Russian oil. He could not say how far this was true, but the popular idea was that the difference arose from the seed being grown in a hotter climate. The best seed was that which came from Archangel, and after that the shipments from Odessa were most esteemed. Another difficulty with the East India seed was, that it soon began to be adulterated with rape and other seeds, which made the difficulty so great to obtain good linseed oil, that at length the Linseed Association of London was formed, and after a time it became a pretty well recognised rule that the price for linseed varied according to the amount of adulteration, and in consequence the seed was now sent in a purer state. With regard to the effect of the air on the drying properties of linseed oil, the idea had been for many years, as stated in the paper, that the oil absorbed oxygen from the air, which added to its drying properties, and in consequence painters were willing to give £2 or £3 more per tun for oil which had been some years in the tanks than for that freshly made. There was no doubt that the oil did undergo a change from the absorption of oxygen, and perhaps also from other causes not yet thoroughly understood. As it was evident, therefore, that oil lying in a tank could only absorb oxygen from the air at the surface, and that thus the process must be an exceedingly slow one, it had occurred to him that this change in the character of the oil might be accelerated by passing air through it. He therefore made some experiments, which showed that by simply blowing cold air through the oil its drying properties were materially increased, and in fact it assimilated in character to old oil; if, however, a slight degree of heat was applied, the oil dried much more rapidly; in fact, if it were heated to about 250°, and then cold air passed through it, the oil so treated was almost equal to that which had been boiled with dryers. So cheap was this process that five tuns of oil could be maintained at the requisite temperature as long as was necessary for about 5s., and there would be merely the additional expense of blowing the cold air into it. If this process were generally adopted, he believed that a very valuable oil might be put on the market, but the chief difficulty was that painters were not willing to pay more for the oil so treated. It also tended to bleach the oil, producing a pale lemon colour, which was in itself an advantage to the painter, and it dried with a most extraordinary lustre. He had seen two coats of paint, made simply with this oil without dryers, put on and dry within two hours. An allusion had been made to sulphuric acid being introduced into linseed oil; the fact was sulphuric acid would not mix with linseed oil, but the oil prepared for white lead grinders was treated with sulphuric acid, and then washed with water, for the purpose of making the oil finer and paler in colour. Mr. Tomlinson had remarked on the adulteration of linseed oil with fish oil. He (Mr. Fordred) had never known of such a case, and thought the difference in colour and smell was too palpable to allow of such a thing being done, but he believed cotton seed oil had been largely used for this purpose. It was an extensive article of commerce in America, where in some parts, after being boiled with litharge or other dryers, it was used almost exclusively for paint. It occupied an intermediate rank between drying and non-drying oils, linseed and olive oils occupying the two extremes. It was much cheaper than linseed oil, and was in consequence so much used to adulterate it that many persons would not have their linseed oil from a mill in which cotton seed oil was also produced.

Mr. Varley expressed the great pleasure he had felt at hearing the paper read, which, he said, had conveyed a clearer impression to his mind than had been produced by a personal visit, some years previously, to a varnish manufactory.

Mr. **Hubbuck** could not agree in the opinion expressed by Mr. Fordred, that linseed oil was adulterated with that made from cotton seed, because, in the first place, if the mixture were put into ice, the latter would immediately fall to the bottom, while the linseed oil would float at the top; and, in the next place, cotton-seed oil had been for some time about 10 per cent. higher in price than linseed. The importation of linseed from the East Indies was a matter which deserved attention. Some years ago not more than 50,000 quarters came from India, while about 700,000 quarters came from Russia; but during the war the trade with the latter country was, to a great extent, suspended, and had never recovered itself; and the supply from India was now as large or larger than that from Russia. The latter, however, was the better article for the painter, for, as a general rule, the colder the climate in which the seed was grown, the greater were the drying properties of the oil, although it was not so good in colour. That from Archangel was no doubt the best, but the supply was so small that, practically, it was not to be had. The adulteration of linseed oil really arose from the fact that the cake which was imported into this country for fattening purposes, still contained a great deal of linseed oil, which it was the custom to squeeze out under hydraulic pressure, and with it came a considerable amount of non-drying oil; and if paint were made with this compound, it would always remain sticky. There was no need for painters to use it, however, because if they went to a respectable firm, and stated the purpose for which they required the linseed oil, they could always get what they wanted. The East India seed produced a thick, glutinous oil, much preferred by soap-boilers, but not so well adapted for painters' use as that made from Russian seed. As to the introduction of sulphuric acid, if that were allowed to remain the oil would not dry at all; but it was the practice to pass a jet of steam through it, which carried off all the free sulphuric acid. English manufacturers always adopted this process, not only with linseed, but also with rape or colza oil; but the French manufacturers were not so careful, and the consequence was that the English oil was much preferred. If linseed oil were boiled properly there need be no increase in the colour; and, therefore, those who wanted a paint which would dry immediately, might always secure it by that means. He (Mr. Hubbuck) sat every day in a counting house that had had four coats of paint laid on in two days, and he had sat in it on the day following. There was no difficulty in the matter; you only required to employ the right people, who would use the right kind of materials, and paint could be made to dry almost immediately. At Mr. Tomlinson's request, he had brought down some boards, showing the comparison between white lead and white zinc paints; the former showed a circular patch, almost black, where a bell-glass of sulphuretted hydrogen gas had been applied, while it had left the zinc unaffected. The bilge water in the holds of ships being impregnated with the same gas, produced the same effect in passing over any paint of which white lead was the basis. Another board was shown covered with paint made from antimony, which was also unaffected by the gas, and which, as well as the zinc, had the advantage for household use, that a room painted with it in the day could be slept in without inconvenience the same night. He had been astonished at the statement in the paper, on the authority of M. Chevreul, that zinc paint would not go so far as lead. His experience was that only two-thirds or three-fourths of the quantity, by weight, of zinc paint was required, although it might, being lighter, look more in bulk. True, he had seen men in Paris using it mixed much too thin, but an Englishman would use it in quite a stiff paste, and, by strength of arm, work it out to the surface required. Zinc white was made by boiling zinc until it rose in a vapour, and when air was admitted, the vaporized metal combined with the oxygen, and fell to the floor of the room like snow, in the form of white oxide of zinc. There was nothing sandy in its consistency, it was perfectly fine, and the less oil mixed with it the better was the result; it only required just enough to keep it together. White-lead, on the contrary, was always granular, however much it might be pulverised, and nothing would make it otherwise. It lay on the surface of the wood, and could be scraped off without much difficulty—there was no key to it, whereas zinc paint would be found to have sunk into the pores of the wood for a considerable distance. [Mr. Hubbuck then exhibited a board which had been painted for twelve years or more, one-half with white zinc paint, and one-half with white-lead, the latter being perceptibly darker in colour.] If a man went into a house on a twenty-one years' lease, and had it painted at the beginning with four or five good coats of zinc paint, it would be at the end of the term in a fit state to deliver over to the landlord, whereas, if gas were used in the house, or if there were any smell from the drains, white-lead would soon be discolored. Mr. Tomlinson had alluded to the use of sulphate of lead, but that was not found to answer in practice, as it interfered with the properties of the linseed oil. The great object was to prevent any sulphuric acid from being mixed with the linseed oil, and although it was neutralized in the sulphate, it was still found to have some effect, and was much better left out. The oxide of zinc was made in America, direct from the ore, and the consequence was, that some of the sulphur, which was present in the coal used in smelting, remained in the oxide, and could never be got rid of, and this affected the paint. In Europe, where the process adopted was to make it from the metal, in a close vessel, from which the coal was excluded, the results were much better. He believed zinc paint would be preferred by all who considered its durability, and the health both of those who worked with it and those who lived in the houses where it was used. It was also to be observed that zinc paint reflected the light, while white-lead absorbed it.

Mr. **Childs** could not agree that white lead was in any way coarser than white zinc. When it was properly levigated, and the dust put under a powerful microscope, some of the particles could hardly be discerned, which he believed was not the case with the zinc. White lead was not fit for the market unless it had been carried a considerable distance by water, flowing at a very slow speed, a process which necessitated its being in a very finely divided state. With regard to linseed oil, he believed one difficulty arose from the fact that unripe linseed made the best cake for farmers, and as the oil was in some respects a secondary product the painters had to suffer. The best oils were always produced from perfectly ripe and matured seeds.

The **Chairman** proposed a vote of thanks to Mr. Tomlinson for the interesting and valuable paper he had read, which had elicited a most practical discussion, although one or two important points had been too lightly touched upon. It was very obvious that during the drying of paint there were chemical changes going on in which oxidation bore a most important part. In the use of these oils they were dealing with substances that contained organic acids, and these, like all other acids, had different degrees of attraction for bases or metallic oxides. Consequently, it did not require any extended knowledge of chemistry to understand that in the use of such oils certain metallic oxides would naturally and necessarily produce much more rapid solidification than others. Oxide of lead had properties which caused it to combine freely with the oil, and thus a part of the solid character of lead paint was due, not merely to the absorption of oxygen from the air, but also to the combination which occurred between the oxide of lead and the acids of the oil. There were other oxides which had a tendency to this combination, amongst which was the oxide of zinc, but the compound was of a different character to that formed with the oxide of lead. It was known, as shown by the observations of Mr. Laing, that certain substances had a great tendency to accelerate the drying of the oil; copperas was instanced, particularly when mixed with lime, as a powerful agent in this direction, and they could easily understand the reason of that. The oxide of iron in the copperas (sulphate of iron) acted upon the oil, decomposed it, and set free the linoleic acid, which was thus enabled to combine with the oxygen of the air, and a rapid solidification was the result. The whole question was somewhat complicated, and although the discussion had only thrown an imperfect light upon it, it showed they were in the right track to elicit a more extended knowledge on this subject than they at present possessed. The inquiry only required to be followed up in the spirit in which it had been commenced to arrive at very practical conclusions.

Mr. Fordred said the copperas alluded to by Mr. Laing was white copperas, or sulphate of zinc, not sulphate of iron.

The Chairman said this did not affect the results stated by him. In each case there was a metallic oxide which produced the effects described.

Mr. Tomlinson said he had been so much interested in the discussion that he had omitted to make notes of it, but he believed it would be considered the most valuable part of the evening's proceedings. It had been said of one gentleman that although not witty himself he was the cause of wit in others, and in the same way, although not a practical painter himself, he had by the paper he had read been the occasion of eliciting valuable technological information from others. He felt sure that if such a discussion had taken place in France, the government would immediately have appointed a commission of competent scientific men, would have paid them well, and in the end a report would have been presented, which would have greatly relieved the embarrassments of painters. He hoped that if any gentleman present had the ear of the new government he would impress upon them the desirability of appointing such a commission, and thus another good result would arise from the reading of the paper.

Proceedings of Institutions.

Yorkshire Union of Mechanics' Institutes.—*Bingley Mechanics' Institute.*—On Monday night the annual *soirée* of this Institution was held in the hall of the Institution. The president, Mr. A. Harris, presided. Mr. Holgate, the curator, read the report, from which it appeared that the Institution has made little or no progress during the year, the class for elementary instruction having been attended on an average by only forty males and seven females on two evenings each. There had been a decrease of sixteen females during the year, the books showing only fourteen females at present members of the Institution, and 229 general members, making, with the annual subscribers, 330 members of the Institution, an increase of three over last year. The income and expenditure showed that the income, with a balance of £39 14s. 8d., was £243 6s. 1½d., the expenditure £233 14s. 1½d., leaving a balance of £9 12s., which, however, was more than absorbed in interest due on the mortgage on the Institution. The Chairman, after the reading of the report, addressed the meeting upon the importance of uniting together, not only to increase the members, but to diminish the debt upon the building. It would be a great benefit to the town of Bingley if freed from debt. He concluded by pointing out to the young the importance of being well educated. The meeting was addressed by the Rev. A. P. Irwine, vicar, Rev. J. H. Mitchell, Mr. H. H. Sales, Rev. E. S. Heron, and the Rev. A. Hudson. *Batley Mechanics' Institute.*—The annual meeting was held on Tuesday, November 29th, in the Town Hall, Batley, Lord Milton, M.P., in the chair. After the report had been read, and the certificates for proficiency in elementary knowledge, awarded by the Yorkshire Board of Education, had been presented by the chairman, addresses were given by Mr. J. Jubb, president of the Institute, Mr. W. St. J. Wheelhouse, M.P., Mr. E. Huth, Mr. Henry H. Sales, and other gentlemen, lay and clerical.

Fine Arts.

Students of Fine Arts at Turin.—The total number of students of fine arts at the R. Academia Albertina delle Belle Arti at Turin is at present 456, divided as follows:—

Architecture	31
Perspective	11
Ornament	138
The figure	102
Wood engraving	3
Painting	23
Sculpture	11
The nude figure	65
Descriptive anatomy	72
Total	456

Manufactures.

Cheap Watch.—It will be remembered that a paragraph appeared in the *Journal* of 9th October last (p. 789), quoted from *Les Mondes*, in reference to a cheap keyless watch, manufactured by M. Theuner, of Neuchatel. The price was there stated at 25 francs, but a communication has since been received from the manufacturer to the effect that this is an error; the price is from 35 to 45 francs.

Aluminium Bronze.—At the meeting of the Academy of Sciences at Paris on the 30th of November, the Count of St. Cricq-Cazeaux proposed to cover the worn-out steps of the column in the Place Vendôme with thin sheets of aluminium bronze. M. Dumas approved of the idea, and reminded the meeting how successfully this bronze was now being used in various kinds of mechanism, especially in saws driven by steam power, which saws, although much thinner, lasted a much longer time than those of steel.

Manufacture of the Extract of Meat.—The *Buenos Ayres Standard*, of 3rd September last, gives the following particulars of the Liebig's Extract of Meat Company's Establishment, at Fray Bentos, on the Uruguay, South America:—"The new factory is a building that covers about 20,000 square feet, and is roofed in iron and glass. We first enter a large flagged hall, kept dark, cool, and extremely clean, where the meat is weighed and passed through apertures to the meat-cutting machines. We come to the beef-cutting hall, where are four powerful meat-cutters, specially designed by the company's general manager, Mr. Geibert; each machine can cut the meat of 200 bullocks per hour. The meat, being cut, is passed to "digerators" made of wrought iron; each one holds about 12,000 lbs. of beef; there are nine of these digerators, and three more have yet to be put up. Here the meat is digerated by high-pressure steam of 75 lbs. per square inch; from this the liquid which contains the extract and the fat of the meat proceeds in tubes to a range of 'fat separators,' of peculiar construction. Here the fat is separated in the hot state from the extract, as no time can be lost for cool operations, otherwise decomposition would set in in a very short time. We proceed downstairs to an immense hall, sixty feet high, where the fat separators are working; below them is a range of five cast-iron clarifiers, 1,000 gallons each, worked by high-pressure steam through Hallett's tube system. Each clarifier is provided with a very ingenious steam tap; in the monstrous clarifiers the albumen and fibrine and phosphate of magnesia are separated. From hence the liquid extract is raised by means of air-pumps, driven by two thirty-horse-power engines, up to two vessels about twenty feet above the clarifiers; from thence the liquid runs to the other large evaporators. Now we ascend the staircase reaching the hall, where two immense sets of four vacuum apparatus are at work, evaporating the extract by a very low temperature; here the liquid passes several filtering processes before being evaporated in vacuum. We now ascend some steps and enter the ready making hall, separated by a wire gauze wall, and all windows, doors, &c., guarded by the same to exclude flies and dust. The ventilation is maintained by patent fans, and the place is extremely clean. Here are placed five ready making pans, constructed of steel plates with a system of steel discs, revolving in the liquid extract. These five pans, by medium of discs, 100 in each pan, effect in one minute more than two millions square feet evaporating surface. Here concludes the manufacturing process. The extract is now withdrawn in large cans, and deposited for the following day. Ascending a few steps we enter the decrystallizing and packing hall, where two large cast iron tanks are placed, provided with hot water baths under their bottoms; in these tanks the extract is thrown in quantities of 10,000 lbs. at once, and here is decrystallized and made a homogeneous mass, and of uniform quality. Now samples are taken and analyzed by the chemist of the establishment, Dr. Seekamp, under whose charge the chemical and technical operations are performed. It may be mentioned that the company's butcher kills at the rate of 80 oxen per hour; separating by a small double-edged knife the vertebræ, the animal drops down instantaneously on a waggon, and is conducted to a place where 150 men are occupied dressing the meat for the factory, cutting each ox into six pieces; 400 are being worked per day."

Commerce.

Coffee in the United States.—Mr. H. E. Moring gives the total stock of coffee in the United States, on the 1st November, as 15,085 tons, against 10,336 tons on the same date last year, an increase of 4,749 tons, or 31 per cent. The total imports to the United States for the ten months ended 31st October were 87,074 tons, against 79,412 tons in 1867, and the monthly consumption this year has averaged 8,466 tons, that of 1867, 7,533 tons, and that of 1866, 6,187 tons.

Madeira Wines.—It appears by Messrs. R. Symonds and Son's *Circular*, that this year's vintage shows a very considerable increase on recent years, and may attain about 4,000 pipes—a quantity still very small compared with that produced in the prosperous days of the island before 1851—and even so, the statement as to present quantity must be taken with some reserve, inasmuch as, since the abolition of the tithes, no official returns have been made. About nine-tenths of the produce was grown on the south side of the island, where the best "Madeiras" were formerly produced, and will probably be good wines, taking into consideration the youth of the plants, and certainly better than in previous years; the remaining tenth, grown on the north side, will be very inferior. Of the total quantity, about three-fourths —say 3,000 pipes—will be required for island consumption, and for conversion into brandy, so that only about 1,000 pipes will ultimately be available for exportation. These will be the best wines of the year; but, before they are shipped, should be allowed some five years to attain thorough maturity. The progress of renewed vine culture is slow, but it is, nevertheless, marked as regards both quantity and quality.

Trade in Silkworms' Eggs in Japan.—Every year a number of agents are sent out from France and Italy to purchase silkworms' eggs in Japan. They are principally representatives of the various *Comizi agrari* (agricultural societies) of the silk-producing districts in Italy (chiefly from Lombardy, Piedmont, and Trent). The agents from France are less numerous. The best grains are purchased by the Italians, and the inferior qualities are sold to the French, who naturally give a lower price. The grains produced in the province of Oschin are most sought after, and the best quality fetch as much as from five to six dollars per card, which contains, on the average, about 25 grammes, or rather less than an ounce. The average price for good seed, however, does not range quite so high this year; the price of good seed was from three to three and a-half dollars per card. The inferior qualities are sold as low as from one to two dollars, but do not find purchasers amongst the Italian agents. To guarantee purchasers in Europe each card is stamped by the European consuls in Japan. At the Italian consulate this stamp is gratuitous, while at the French a sum of one dollar per hundred cards is charged. Some of the representatives of Italian houses of good standing have discontinued having their cards stamped, as their signature is sufficient guarantee to insure the quality of the seed. The quantity of seed produced during the present year by agents sent out to Japan, and by the various firms established at Yokohama, for European houses, amounts probably to not less than two millions of cards, or more than double of that produced last year, the total exports from Japan in 1867 being 832,000 cards of seeds, of which 515,000 were purchased by Italian houses, and 317,000 by French; the total value being upwards of two millions of dollars. Yokohama is the great market for silkworms' eggs; a considerable quantity of seed is also obtained at Osaka, but of an inferior quality, ranging in price from one to two dollars per card; this, however, does not find purchasers amongst the representatives of the Italian houses. The cards are packed in cases, which contain from 200 to 300, the most usual size being that which contains 200, weighing 18 kilogrammes. The cards are placed ten by ten in grooves, so as to have a small space between. Formerly the cases were closed hermetically, but now a tin plate, perforated with small holes, is placed at each end, so as to allow ventilation. In the island of Nippon there are twenty-one silk-producing provinces, the richest being Oschiri, and having an area of 2,500 square miles. The total production of the twenty-one provinces is about 4,300,000 kilogrammes of silk, or 86,000 bales of 50 kils. each. This is nearly double the total production of France, and about equal to that of Italy and Spain together. The principal market for Japanese silk is Kioto, situated about 30 kilometres distant from Osaka. The opening of the port of Yokohama, in 1859, to commerce, has had a most beneficial effect upon the silk trade in Japan, the price having increased 100 per cent., and the production at least 25 per cent. Up to the present time a preference has been shown, by both the French and Italians, for the Suez route, for sending the seed to Europe. But since the establishment of the French Transatlantic service between St. Nazare, Aspinwall, Panama, San Francisco, and Japan, there is every reason to anticipate that this line will be chosen in preference for the future by purchasers of seed. The service will be fully organised by next season, with regularity in the arrivals and departures, and the length of time employed between Japan and Europe will in no way be increased, and, moreover, the voyage through the tropics will be lessened by twelve days, and there will be less fear of the seed suffering the effects of the tropical heat than there is by the present mode of transport, passing by the Chinese and Indian Ocean. About 300 cases were sent *via* San Francisco last year, and arrived in Europe in a perfect state. Another advantage in this route is the saving in freight on the Suez route, which now costs about 33 centimes per lb. by the latter, and 28 centimes per lb. by the former.

Bitumen in Sicily.—An important deposit of bitumen is about to be worked in Sicily by a French company, who have lately purchased a mine in the neighbourhood of Ragusa, in the province of Siracusa. Its quality is said to be superior to any that is found either in Belgium or France. The area of this deposit is about seventy-four acres. The company is also in treaty for the purchase of other mines in the same district where bituminous deposits are most abundant.

Colonies.

Cotton in Queensland,—A Brisbane paper says:—"There is a growing impression that this staple is one of the safest, if not the most remunerative, that Queensland growers can invest in. Confidence is felt in the crop as experience is gained, and it is found that instead of five or six acres a family can manage twenty or thirty. There is much uncertainty in the colony on the best methods of ginning. English brokers have represented that the Queensland staple is cut and broken in the ginning process, and recommend roller instead of saw-gins. Experienced men in the colony, who know how cotton is turned out in America, India, and elsewhere, maintain that the picking, sorting, and ginning of Queensland cotton is remarkably well done, and that the fault of irregular staple is owing to the mixed seed used in the colony, and that the gins break it here no more than they do in other countries."

Manufactures in New South Wales.—The galvanizing manufactory of Mr. Zollner consumes a by no means small quantity of sheet iron in the course of a year; and it is a branch of trade that is yearly growing in importance. In a community like that of New South Wales, of which so large a proportion of the population is engaged in mining pursuits, anything that gives facility for the development of the mineral resources of the colony must be of great advantage, as well to the community at large as to the miners themselves. The substitution at the mines of galvanized tubs and buckets, for the ordinary wooden articles previously used, has been a great boon to the miners; and now that they can be supplied at a less cost than the easily destroyed wooden implements, the expense of the miner's outfit has been considerably reduced. The sheet iron used in this work has as yet to be imported expressly for it. It is essential to the success of the galvanizing operation that the sheets of metal should be perfectly clean and free from rust. To secure this, they have to be carefully packed prior to exportation, in zinc-lined waterproof cases; and the expense of all this care brings up the cost of material to something beyond that of ordinary sheet iron. Yet, in spite of this, articles of galvanized iron are now, by the application of labour-saving machinery, and by a proper distribution of labour, made up in the colony at a price which not only competes with the imported article, but which has succeeded in completely shutting out the foreign article from the colonial market.

Cape Wines.—By the last mail from the Cape of Good Hope, we (*Produce Markets Review*) learn that "The Cape merchants have taken up the question of the depressed state of the wine trade, and were about to hold a conference with the Paarl residents, to obtain information, with the view of farmers and merchants forming a company, for the purchase, storage, and export of wines, of age and quality. Wine farmers are in great distress, in consequence of low prices, and immediate relief was required. To our mind, the reform wanted in the Cape vineyards is, to give up the spurious imitations which have made 'South African Port' a compendious description of all that is nasty in wine, and to manufacture instead lighter and more natural descriptions. With such a climate, the quality of Cape wines should be magnificent, and if it is not so the fault is probably man's—not nature's."

Extension of Territory in Australia.—A Melbourne paper says:—"Settlements have now been formed from Rockhampton to Somerset, on the York peninsula, from Cooper's Creek up and along the Gulf of Carpentaria, thus adding immensely within the last few years to the available territory of the British dominions in Australia. The example set by these enterprises in the East was soon followed by South Australia; and fine runs are continually being opened towards the centre of the continent, and along the track originally laid out by the indomitable pluck of M'Dougal Stuart. Western Australia, apparently not so favourably situated as her sister colonies on the east coast, is struggling hard for an extension of her territory, both towards east and north; and one of her most recent achievements—the successful occupation of the land round Nicol Bay and along the Fortescue and Ashburton rivers—places it beyond the reach of doubt that the north-western coast will one day likewise become a fine settlement. In the far north, on the shores of the Van Diemen's gulf, the efforts to establish new settlements have not been crowned with equal success; for only a short time ago the South Australian branch colony at Adam's Bay, after a struggle of nearly three years, had to be abandoned again. The same government has, on the other hand, succeeded in discovering an excellent harbour and starting-point for the occupation of the land round the Great Australian Bight, which, though on Western Australian territory, will ultimately prove of great importance also to the western districts of South Australia. Notwithstanding all these efforts and explorations, there still remains a vast territory between Cambridge Gulf in the north and the Australian Bight entirely unknown. The successful settlement of the north-western seaboard will depend ultimately on the progress made in the exploration and occupation of the western interior; for so long as there still remains an unknown territory of nearly a million of square miles between the eastern and western colonies, there is little hope that the latter can attain to a really prosperous condition. But let the communication once be fairly established, and there can be no doubt that it will give an enormous impulse to the progress of every one of the colonies."

Publications Issued.

The Indicator Diagram Practically Considered. By N. P. Burgh, Engineer. (*E. and F. N. Spon.*)—It appears by the preface that this work was virtually commenced in the latter part of the year 1867, when the author had occasion to test some indicator diagrams. The means he adopted were to consider, first, the proportions of the details that regulated the admission, expansion, and exhaustion of the steam; and, secondly, their geometrical delineation. It was then concluded that as the length of the motion for the indicator barrel was virtually that of the stroke of the piston, the scale of the geometrical test employed must be subject to that circumstance. Accordingly a drawing was made of the cylinder ports slide valve, link motion, eccentrics and rods, a portion of the piston, length of the connecting rod, and crank circle at the same scale that the stroke of the piston in inches was equal to the length of the indicator diagram. From this resulted a correct knowledge of the positions of all the details that regulated the steam at all points of admission, cut off, expansion, exhaustion compression, and lead in relation to the positions of the piston and crank pin at the same scale as the diagram; and by laying it on the circle it was apparent how it was formed in relation to time and speed, and the cause of the defects, if any existed; indeed, this is the only method of gaining that information truthfully, which is illustrated by the frontispiece plate. After this test had succeeded the author looked around him to see if any one else had published a similar process, but could not find any record, or even a hint on the subject. He therefore thought it worth while to put the matter in print for public use, intending at that time to make a small work only on that special branch. On conversing, however, with a few of his professional friends on the affair, they urged him not to condense the matter thus, but to make a really practical work on the entire subject, as it was much needed, at the same time offering him all the assistance necessary for the purpose; and accordingly Messrs. Penn, Field, Barclay, Rennie, and Napier assisted him; and no author but himself has been so honoured with their contributions, not only in this case, but in others when he has solicited information from them. The most reliable information on the indicator diagram, in ten chapters, is therefore made public in the following order:—Chapter I. contains the description and use of the indicator, illustrating, on a working scale, Messrs. Maudslays' and Mr. Richards' indicators.—Chapter II. is under the heading, "How to take an indicator diagram correctly," and treats of the action of the steam in the cylinder, the definition of the diagram, correct indicator gear for horizontal, vertical, and oscillating engines, and indicating notes.—Chapter III. deals with the proof of atmospheric pressure and particulars of steam pressures, and also includes rules and tables bearing on the subject, with practical examples and illustrations.—Chapter IV. is a complete description and illustration of the theoretical geometry of the indicator diagram in a more practical manner than hitherto published.—Chapter V. is the practical geometry of the indicator diagram, which fully explains the frontispiece-plate and other figures in connection with it.—Chapter VI. commences the illustrations of indicator diagrams and gear constructed by the engineers mentioned, and others whose names are noted under the figures; this chapter contains twenty-one diagrams from ordinary modern screw-engines of all classes; three from compound engines; two illustrations of indicator gear for return acting engines; and three diagrams of steam-launch engines.—Chapter VII. is devoted to diagrams taken from the most modern paddle-engines, and contains two illustrations of them; also the most improved indicator gear by Messrs. Penn and Napier.—Chapter VIII. treats of land engine indicator diagrams, showing eleven examples taken from various classes, including locomotive engines.—Chapter IX. fully explains and illustrates air and water pump diagrams.—Chapter X. closes the work, with the explanation of the indicated horse-power in connection with the diagram. The whole of this is expressed in 160 pages, and illustrated by 100 wood-cuts; so that the entire matter has been fully explained, but not more so than requisite.

Notes.

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Technical Education in Italy.—The mining school at Agordo has just been re-opened, with some slight modification in the courses of instruction on those of previous years. These courses are gratuitous, and occupy three years' study in the following subjects:—First year—Elements of mathematics and geometrical drawing; chemistry; elements of physics and natural history. Second year—Mining and underground surveying, with the relative drawing; analytical chemistry, with laboratory practice; mineralogy and geology. Third year—General mechanics as applied to mining purposes, with relative drawing; mineralogy; principles of construction.

Industrial School at Constantinople.—According to the *Takvimi Vekxi* (the official journal of the Turkish government) an industrial school is about to be established at Constantinople by order of the Sultan.

Agricultural Societies in Prussia.—In Prussia there are 31 general agricultural societies, with 640 branch committees in the various provincial towns. There are also 166 smaller independent agricultural societies.

Emigration from Italy to South America.—The following is the emigration from the port of Genoa to South America during the month of May, 1868, as compared with that of the same month, in 1867:—

	1867.	1868.
No. of ships	12	11
No. of crew	162	241
No. of passengers	742	866

Of this number in May, 1868, 179 emigrants were from the province of Genoa, 109 from that of Como, 60 from Milan, 152 from Salerno, 48 from Potenza, 20 from Novara, 41 from Pavia, 37 from Turin, 33 from Lucca, 29 from Brescia, and 25 from Alessandria. The emigration from Genoa during the first five months of the present year, as compared with a similar period of 1867, was as follows:—

	1867.	1868.
No. of ships	57	59
No. of crew	807	1,218
No. of passengers	5,669	8,127

Joint-Stock Companies.—The following summary of a return relative to Joint-Stock Companies shows the decline of the limited liability mania during the last five years:—In 1863 there were 783 companies registered, with a proposed capital of £139,988,242; in the following year the number increased to 992, with a proposed capital of £237,437,083 14s. Since then the falling off has been rapid, as shown by the following figures:—

	Companies.	Capital.
1865	1,013	£205,391,818
1866	752	76,824,823
1867	469	31,444,982
1868 (Jan. 1 to May 31)	201	13,896,182

Population of the United States.—The population of the United States has increased steadily during the last sixty years, as will be seen by the results of the census, which have been made every ten years:—

1790	3,930,000
1800	5,306,000
1810	7,240,000
1820	9,638,000
1830	12,866,000
1840	17,069,000
1850	23,192,000
1860	31,445,000

At the present time the population of the United States is upwards of 40,000,000, and has doubled itself in twenty-three years, increasing three and a-half per cent. in a year, or thirty-five per cent. in ten years. Should this rate of increase still keep the same, the population will be in:—

1870	42,450,000
1880	57,302,000
1890	77,357,000
1900	104,431,000

The population of Mexico and the British possessions amounts to from twelve to fifteen millions of inhabitants.

Education at Turin.—The total number of pupils at the municipal schools of Turin entered for the scholastic year, 1868-9, is 14,358, an increase on that of the preceding year of 802, and may be classed as follows:—

Day Schools.	
Boys	4,936
Girls	4,447
Boys and girls in suburban schools	2,105
Evening Schools.	
Technical classes	1,305
Elementary classes	1,520

Treatment of Seed Wheat with Sulphate of Copper.—The preservation of seed wheat from destruction by means of sulphate of copper is recommended and adopted largely in France; and a farmer communicates his method of applying the solution to the *Journal de l'Agriculture* of Paris, and his letter, together with an illustration, may be found in the last number of that journal, published on the 20th of the last month of November. The apparatus used is of the simplest kind. A table on tressels, one of which is three or four inches higher than the other, so that the former is on an incline, a border of planks nailed around the edges of the table, with an opening in one side at the lower end, to allow of the seed being drawn out when saturated; the plank at the lower end of the table is pierced at the bottom all along its central half with a number of small holes, and beneath these stands an ordinary tub. The tub is nearly filled with a solution of sulphate of copper, in the proportion of eight pounds of the salt to seven or eight gallons of water. The operation is easy enough. The seed-corn is brought in a double-handled basket, and is then dipped into the tub of solution; the contents of the basket are then turned out upon the table, and the surplus solution runs back into the tub, through the holes in the plank, already described. If there is a large quantity of seed to be steeped, of course the solution in the tub must be replenished. A pound of the salt is said to be sufficient to saturate three hundred times, or more, its own weight in corn. The dipping, shooting on to the table, and the draining must do away with the chance of any of the grains escaping the solution.

The Brindisi Route.—The Southern Railway Company have recently purchased a large building near the railway station at Brindisi, which they are now fitting up as an hotel for the accommodation of passengers proceeding and returning from the east. This hotel will be provided with every accommodation for travellers, and will have gardens, baths, billiard rooms, &c., attached. The Railway Company are also about to establish a line of steam ships to Bombay, which will make the voyage in twenty days, a saving in time of four days, and in fare of 300 francs, on the route *via* Marseilles.

Correspondence.

Poisonous Mushrooms.—Sir,— Mr. Worthington Smith's description of the *bonâ fide* mushroom seems to me a very good one, but I doubt his correctness as to their never growing in woods. I have never found the best sorts in dense woods, but in open woods I have found them wholesome. The fact of a fungus growing in a wood does not appear to indicate its being unfit for food, for some of those which are now named as "excellent and delicious" by Latin titles, grow in woods. Undoubtedly, however, those mushrooms which grow on open downs are the best. My remarks as to the test by pungency seem to have been somewhat misunderstood. I only applied this test to a kind or two which much resemble mushrooms, and never suggested that they would supply a reliable test in the case of other fungi. Wherever I have found a mushroom which has seemed to me doubtful, I have applied the above test of tasting in the raw state—and I have been a great gatherer of mushrooms, from my youth, in various parts of England and Wales, and have never been unfortunate in my sport (for sport it is if you choose to make it so) and it leads you into places as pretty as trout-fishing does. Indeed, I have often gathered mushrooms by the side of trout streams, and when the fish would not rise, have put some leaves into my creel, and filled it up with fungi. I say I have been fortunate in my mushroom sport. Indeed, I am not aware even that I have been "*particeps criminis*" to even an indigestion. But there are several reasons which produce such various accounts about the wholesomeness, or the contrary, of mushrooms. With some people it is very probable that any mushrooms would be unwholesome, just as one finds people who could not eat eels or shrimps without being very poorly afterwards. Then, there is the want of proper cooking. In a former letter to you on this subject I gave a notable instance of a wonderful fungus, like a cauliflower, in Italy, which was cooked by some friends of mine in two or three waters, and was excellent, and was eaten without the least ill effects. But this emboldening some other people to try the same species of fungus, they, unfortunately, only boiled it once, and were very ill. Heaven sends fungi; perhaps it is some one else who sends cooks! Then there is another reason which would make even roast beef a poison. If people gorge themselves on mushrooms, and are ill after it, it serves them right. Fancy anyone making a dinner off *pâté de foie gras.* Such an one would deserve to be ill, and it would be a pity if he was not. These savoury materials are intended to be adjuncts. Used as adjuncts, or as *petits plats*, they are excellent, but not for the staple of a meal. I do not think there would be many cases of mushrooms injuring people if they were thus used in moderation. For an excess there is no excuse for the richer classes. For the poorer there is. They cannot afford a variety of dishes, and if their one turns out bad they are sufferers to be pitied. And, as far as I can recollect, the cases of serious injury from mushrooms have principally occurred among these, when a meal has been made of wrong sorts, or such as have been decayed and unfit for food, although originally they might have been good enough. People should understand that they should not make a meal of mushrooms any more than they should off *pâté de foie gras;* and then I do not think that there will be much injury done. People do not generally make a meal off truffles, or onions. The former instance will illustrate the suggestions to the richer class; the latter to the poorer; the full investigation, however, of this source of food is, I gladly see, fairly within the province of the Society to foster.—I am &c., John Bell.

The Safety of our Collieries.—Sir,—The work carried out underground by miners is such that they must ever be subject to occasional unforeseen accidents, but we shall never be in a position to reduce those so frequently caused by bad ventilation, ignorance, and mismanagement, until we get rid of a wretched, false economy, introduced in former rude and *quasi* semi-barbarous times when coals were first begun to be obtained from the bowels of the earth. A shaft was sunk near the lowest dip of the strata in order that underground water might flow to the sumph, or pump-well, and so drain the whole of the works. Thus far the operation was judicious, but when, instead of sinking a second, they came to divide the one shaft in two with a bratticed partition, for both down and upcast, and for other purposes, a series of fatal errors were introduced. In the first place fire-damp or impure hydrogen is lighter than atmospheric air, therefore a less power of ventilation is required when the upcast is sunk more towards the higher level of the coal measures than when at the lowest. The cost of two shafts was an expense that colliery owners formerly would not hear of—a false economy, the cause of many accidents and stoppages. In the second place, as exhaustion is generally considered the best mode, and the furnace the cheapest, the custom is to put it half way down the upcast, in order to save the expense of building a high chimney, and so force the foul and explosive gases through the fire bars with great risk of accidents and stoppages. In the third place, since the introduction of the safety lamp, that invaluable test of the state of the air of the mine, the men have been enabled to work in a poisonous atmosphere, highly detrimental to health, and shortening by many years the duration of working life. It has indeed been observed that since that introduction fatal accidents have been more frequent, but I believe that opinion to be founded in error, from not taking into consideration the great increase of collieries of late. Probably the proportion is much the same—a sign that the use of the lamp has not produced much benefit. More than all, it is highly improper to cause the life of the miner to depend upon strictly carrying out minute regulations, upon his own carelessness or ignorance, or upon the perfect state of the lamp, itself subject to various unavoidable—sometimes wilful—accidents. In order to carry out the management of our collieries with safety and economy, the ventilation should be entirely independent of the miners themselves, who should be enabled to work as freely as above ground, save in respect of the confined space and liability to suffer from falls, though they, again, are often caused either by improper cutting or insufficient timbering. The fact is that the very prohibition of smoking below is a certain indication of bad or insufficient ventilation, and a law to compel owners and lessees to defray every expense attending or following colliery explosions would be a most salutary move. I merely throw out these few crude suggestions in order to start the subject.—I am, &c., HENRY W. REVELEY.

Reading, December 8th, 1868.

MEETINGS FOR THE ENSUING WEEK.

MON......Society of Arts, 8. Cantor Lectures. Mr. W. H. Perkin' "On the Aniline or Coal Tar Colours."
Society of Engineers, 7½.
R. Geographical, 8½. Dr. H. Blane, "Journey in Western Abyssinia, from Metemma to the King's Camp in Damot."
British Architects, 8.
Medical, 8.
London Inst., 6.
TUES ...Civil Engineers, 8. Mr. Samuel Parker Bidder, jun., "On Machines employed in Working and Breaking-down Coal, so as to avoid the use of Gunpowder."
Statistical, 8. Dr. Robert J. Mann, "Statistical Notes regarding the Colony of Natal."
Pathological, 8.
Anthropological, 8.
WED ...Society of Arts, 8. Dr. B. H. Paul, "On Artificial Freezing."
R. Society of Literature, 8½.
THUR ...Royal, 8½.
Antiquaries, 8½.
Linnæan, 8. Mr. Andrew Murray, "On the Geographical Origin and Relations of the chief great Coleopterous Faunæ."
Zoological, 4.
Chemical, 8.
Numismatic, 7.
Philosophical Club, 6.
FRI ......Philological, 8½.
Quekett Club, 8.

Patents.

From Commissioners of Patents' Journal, December 4.

GRANTS OF PROVISIONAL PROTECTION.

Advertising, mode of—2870—J. H. Johnson.
Agricultural machines—3544—C. J. Foster.
Bamboo, &c., preparing fibre from—3245—M. Sautter.
Boxes for packing bottles, &c.—3514—W. Thompson.
Carding engines—3481—E. and A. Priest.
Carding engines—3548—J. Bowden and M. N. and B. R. Mills.
Carriage wheels—3450—J. Stephens.
Carriages, folding steps for—3554—B and B. T. Newnham.
Cartridges, renovating discharged—3509—W. L. Groundwater.
Cast iron, converting into wrought iron—3565—C. D. Abel.
Chairs, cradles, &c.—3547—J. Mangnall.
Chimney pots—3493—J. E. H. Harris and T. Lumley.
Coal, &c., breaking down—3488—J. Jones and S. P. Bidder, jun.
Conservatories, &c., heating water for—2288—F. Warren.
Corn-flour jelly—3378—W. Irmer.
Electro-telegraphic apparatus—3556—W. A. Lyttle.
Fabrics, fixing colours on textile—3534—C. Descat and H. Guillaume.
Fabrics, manufacturing and ornamenting—3542—J. Sims.
Feet, &c., imparting heat to the—3519—D. Jones and J. Jackson.
Fire-arms, &c., breech-loading—3512—G. V. Fosbery.
Fishing rods—3528—B. Britten.
Game, apparatus for playing a new—2990—H. Jewitt.
Gas—3541—C. E. Brooman.
Ginger snaps, &c.—3497—A. Clark.
Hay and straw, baling chopped—3536—W. R. Lake.
Heavy weights, safety tackle for raising and lowering—3567—J. H. Johnson.
Iron and steel, &c.—3569—C. W. Siemens.
Iron ships, constructing—3508—B. Bell.
Kilns—3496—W. Mansfield.
Land, tilling by steam power—3487—S. W. Campain.
Lead ores, treating—3400—P. E. De Wissocq.
Lime, burning—3561—J. R. Swann.
Locks—3549—W. La Penotière.
Looms—3499—C. Richardson.
Metallic caps, &c.—3557—J. Sturrock.
Millstones, dressing—3559—A. V. Newton.
Motive-power apparatus—3492—G. Montrichard.
Motive-power engines—3463—G. J. Worssam.
Needle cases—3517—W. Avery and A. Fenton.
Pen-holders—3500—J. M. Prichard.
Phosphate of lime—3516—H. Carrigg.
Phosphatic manures, &c.—3506—A. McDougall.
Phosphorus, &c.—3515—C. D. Abel.
Pianoforte hammers—3563—W. H. Dreaper.
Pianofortes—3375—T. Harrison.
Pianofortes, &c.—3558—C. Montagu.
Pig skins, treating—3309—W. H. Liddell.
Ploughs—3526—A. Guthrie.
Railway carriages, movable sleeping berths for—3552—J. Howlison.
Railway signals, &c., apparatus for working—3498—H. A. Kehde.
Rope, &c.—3521—J. Green.
Ropes, untwisting—3523—J. McGlashan.
Rotary engines and pumps—3403—H. L. Bennison.
Safety lamps—3413—W. H. Hall and J. Cooke.
Saws, operating reciprocating—3532—W. R. Lake.
Sewing needles—3535—A. V. Newton.
Sheep, &c., washing, &c.—3510—W. T. Bassett.
Ships, propelling—3218—C. Shaw.
Shirts—3520—J. McGrath.
Stays—3494—L. M. Prewitt.
Steam engines, &c.—3546—W. Inglis.
Steam generators—3479—P. J. Ravel.
Steam hammers—3545—F. W. Webb.
Stereotype printing machines, &c.—3470—J. C. MacDonald and J. Calverley.
Tables, apparatus for expanding—3483—J. Hare.
Telegraph wires, covering—3490—R. Green.
Telegraphic line wires, fastening and adjusting—3501—C. W. Siemens.
Tobacco pouch and cigarette former combined—3539—C. D. Abel.
Tumblers, goblets, &c.—3518—T. G. Webb.
Vegetable and animal substances, preparing and preserving—3352—M. Sautter.
Water, &c., distributing in fine particles—3531—H. B. Cowell.
Window sashes, opening and closing—3524—J. D. Judkins.
Wood, &c., machinery for shaping—3429—J. Lewthwaite.
Wool, &c., liquid for oiling—3503—C. E. Brooman.
Wool, &c., preparing—3538—J. Scholes and J. Leach.
Wort, &c., cooling—3507—A. W. Drayson.
Yarns, preparing—3537—J. G. Tongue.

PATENTS SEALED.

1301. J. C. and H. T. Fugl.
1849. A. Prince.
1851. O. T. and G. A. Newton.
1852. J. Wadsworth
1864. G. Finnegan.
1881. R. B. Boyman.
1981. W. S. Carr.
2011. W. A. Gilbee.
2013. A. M. Clark.
2014. C. Whitehouse.
2042. E. Mucklow.
2096. A. M. Clark.
2296. J. H. Johnson.
3003. B. W. Stevens.
3063. W. E. Newton.

From Commissioners of Patents' Journal, December 8.

PATENTS SEALED.

1876. R. Husband.
1883. J., J. W., & D. S. Stafford.
1888. W. Ferrie.
1889. J. T. Ladyman.
1892. C. W. Siemens.
1901. T. E. Williams.
1910. W. Henderson.
1911. J. S. Cockings and A. Umbach.
1913. J. Lord.
1914. A. E. G. Thenard.
1917. A. S. Stocker.
1927. N. D. Spartali.
1931. W. Richards.
1961. J., J., and J. Booth.
1964. D. Mitchell.
1972. A. M. Clark.
1993. W. Umpherston.
2087. C. E. Brooman.
2097. W. Daglish.
2356. F. Lambe, A. C. Sterry, and J. Fordred.

PATENTS ON WHICH THE STAMP DUTY OF £50 HAS BEEN PAID.

3071. W. Thompson.
3123. I. Holden.
3093. T. A. Weston.
3095. E. B. Wilson.
3143. N. Salamon and W. J. L. Davids.
3172. A. V. Newton.
3326. R. M. Marygold and S. Fitzjohn.
3127. G. E. Donisthorpe.
3130. A. B. Brown.
3163. A. Parkes.
3233. T. R. Hetherington and S. Thornton.
3116. J. J. Ashworth.
3142. A. C. Bamlett.
3153. P. de Moudésir, P. Lehaitre, and A. Jullienne.
3174. R. A. Brooman.
3184. N. W. Wheeler.
3379. G. Hawksley.

PATENTS ON WHICH THE STAMP DUTY OF £100 HAS BEEN PAID.

3066. J. J. Russell & B. L. Brown.
3031. G. T. Bousfield.
3078. C. F. Varley.
3060. J. D. Napier.